GREEN MATTERS

A newsletter from the Alberta Environmentally Sustainable Agriculture Council

Fundamental & Fragile:

Protecting Our Soils

"Six inches of topsoil stand between us and starvation," was the opening statement in my college "Intro to Soils" course. I don't remember much of that class, but the importance of protecting our soils has stuck with me ever since. While water often tops the list of concerns when we talk of environmental issues, soil is the basis for our crops, pastures, trees, wild plants – all land-based ecosystems.

Most *Green Matters* readers have had dirt stuck under their fingernails at some point. But soil quality, quantity and health are often taken for granted. This issue of *Green Matters* reviews some of the important, ongoing and often unsung work to understand, measure and protect one of our most basic resources.

We exist on a fragile landscape. Living in southern Alberta, I immediately think of the water erosion risk in the Eastern Slopes of the Rocky Mountains, the wind erosion risk on the southern plains, and the impacts of resource extraction. But soil degradation and loss can happen anywhere.

The 1930s taught us that human activity plus drought can turn prairie soils into dust storms. The good news is that, in our last major drought, soil erosion was minimal due to no-till farming practices and better understanding of how to work with our soils.

Advances in our knowledge and practices are continuing. The first article in this issue tells about current field studies in southern Alberta to find better options for minimizing erosion on irrigated land.

Some of those field studies rely on plot work, an integral part of agricultural research. Landscape-based monitoring, another approach to soils-related research, has been coming to the fore over the last decade or so. Alberta researchers have been leaders in this approach. The second article in this issue describes one example: the Alberta Environmentally Sustainable Agriculture (AESA) Soil Quality Benchmark Study. Each of the study's sites is monitored at three locations

AAFRD

– the upper, middle and lower positions on a slope. This approach provides an understanding of the range of soil conditions that producers work with every day. And it's one reason why the study's unique, long-term, province-wide dataset is so popular with other scientists who are using the data in diverse investigations.

The third article looks at a project that takes the landscape approach one step further – sampling from the hill tops all the way down to the bottoms of wetlands – in order to understand greenhouse gas dynamics. With the Kyoto agreement now in place, continued work is needed on the soil's role in greenhouse gas emissions and potential for carbon sequestration. This project at the Parkland Conservation Farm will help us understand our soil's potential across an entire agricultural landscape.

The final article is about the AGRASID database, six decades' worth of Alberta soil survey data converted to digital form. The wealth of information from plot work, landscape-based monitoring and comprehensive databases provides key tools for progress in agricultural land management.

Managing our soils for long-term sustainability will always be a combination of passion for our landscape, knowledge based on science, and experience built on mistakes. Alberta farmers are protecting the soils we rely on, and the work of AESA staff and partners continues to contribute to our ability to improve our practices in the future.

From AESA Council's Chair

by John Kolk, Poultry Industry Council

WHAT'S INSIDE

Issue No.23, Spring 2005

Erosion Control in Irrigated Crops: New Possibilities

The irrigated lands of southern Alberta offer the opportunity to grow high-value crops like potatoes, beans and sugar beets. However, these crops tend to increase the risk of wind erosion, which can lead to the loss of topsoil, nutrients and productivity. Now Alberta researchers are opening the door to some new options to protect the soil and sustain production of these crops.

Rob Dunn of Alberta Agriculture, Food and Rural Development (AAFRD) explains that sugar beets, beans and potatoes produce low amounts of crop residue. As well, current planting methods for these crops rely on burying previous crop residues, leaving the surface more erosion prone. In addition, southern Alberta's winter Chinooks contribute to repeated freeze-thaw cycles that break down soil roughness, increasing the wind erosion hazard through the vulnerable winter and spring period until the next crop is established.

"We can't eliminate the risk of erosion in these low-residue crops, but we can minimize it," notes Dunn. Farmers currently use various erosion control methods such as: inclusion of a cereal crop every second year in the rotation because cereals tend to produce high levels of residue; creating ridges or soil clods to increase surface roughness; applying and crimping in straw or spreading manure; and growing a cover crop.

None of these options is perfect for every situation. Although cereal residue reduces erosion and conserves moisture, too much residue can result in cooler soils, which can reduce seedling vigour and increase the risk of frost damage for a crop seeded into the residue. Freeze-thaw cycles and wind can gradually break down soil clods. Applying straw or manure may not be practical for large areas, and the straw or manure must be well anchored. And cover crops aren't always practical because potatoes, beans and sugar beets are often harvested too late in the year for the cover crop to grow sufficiently to provide over winter cover.

> "We can't eliminate the risk of erosion in these low-residue crops, but we can minimize it."

So several researchers are evaluating alternatives. For example:

- Dr. Jim Moyer of Agriculture and Agri-Food Canada (AAFC) at the Lethbridge Research Centre is investigating several winter and spring cereals as post-harvest cover crops. Fall rye broadcast just before potato harvest or seeded immediately after bean harvest has given the best soil protection.
- Dunn is field testing winter wheat planted with a hoe-type drill following beans or potatoes harvested in early to mid-September. The fall-seeded crop isn't seeded early enough to provide good winter cover, so the surface roughness created by the drill gives some protection.
- AAFC's Dr. Bob Blackshaw at the Lethbridge Research Centre is studying various crop stubble and cover crop scenarios for no-till planting of narrow-row dry beans. Beans planted directly into a fall-planted fall rye cover crop treated with glyphosate herbicide appears to be one of the best options in terms of yield and weed control.
- The M.D. of Taber teamed up with a local aerial applicator to demonstrate oats as cover crop for potatoes. Oats were spread by plane and incorporated by the harvesting operation. Farmers have used fertilizer spreaders to apply the cereal, but spreading by plane is very attractive given the busy workload at harvest.

Rob Dunn/AAFRD

A cover crop in late fall: This winter wheat/barley mix was broadcast before harvesting potatoes in late August.

Beating soil erosion in sugar beets

An intriguing possibility for sugar beets grown after a cereal crop is called zone tillage. A beet grower southeast of Taber who has been experimenting with this approach caught the attention of Dunn and researchers from Rogers Sugar, which processes sugar beets at its Taber plant.

Zone tillage is used in row-cropping systems. It confines seedbed preparation within strips in a residue-covered field. The beets are seeded into the prepared zone, while the untilled areas provide erosion protection until the beet crop is established.

The Rogers Sugar researchers are comparing zone tillage with a conventional beet production system, measuring such aspects as yields and soil temperature effects. With funding assistance from Reduced Tillage LINKAGES and Rogers Sugar, AAFRD's Lawrence Papworth developed a zone tillage machine last year for Rogers Sugar to use in its study. The Rogers Sugar researchers have field tested the unit, and now Papworth is fine-tuning the unit's design.

Along with reducing erosion, Dunn says zone tillage could offer other advantages like conserving seedbed moisture and reducing the risk of seedling injury during a soil blow-out event in early spring. He is also hoping to team up with bean growers to investigate using zone tillage in bean production.

On the Verge of Discoveries

AESA's Soil Quality Benchmark Study is poised for progress. As one of a handful of long-term soil quality monitoring programs in North America, it is providing a unique, comprehensive dataset for understanding soil quality changes in Alberta's agricultural soils.

"It's an exciting time because we're on that event horizon of being able to start picking up more trends out of the data," says Dr. Jason Cathcart, the AESA Soil Quality Program Coordinator.

The study, which began in 1997, has several major objectives: to create a dataset for use in testing and validating models for predicting changes in soil quality; to provide baseline soil quality information; and to monitor changes in soil quality.

The 42 benchmark sites cover all agricultural ecoregions in Alberta. Each site has been selected to be representative of the soils, landscape, climate and agricultural practices in the area. Samples are taken annually and analyzed for a wide range of soil characteristics, such as various forms of organic matter, nutrients and pH, as well as crop yield and biomass.

At each site, samples are taken at three locations – the upper, middle and lower positions along a slope. This approach adds a valuable dimension because landscape processes can influence soil quality. Cathcart explains, "A classic example is removal of the upper soil layers on the crests of hills by water erosion, and the accumulation of that material in the lower depressional areas. That can result in quite different responses in crop yield or nutrient requirements with only about a metre of elevation change [across a field]."

"...we're on that event horizon of being able to start picking up more trends out of the data."

Data from the study's first five years have been analyzed, but most soil characteristics did not yet show statistically significant trends. The main exception was the pattern of soil characteristics along a slope, which had significant results for quite a few soil properties. The trends were as expected, with lower slope positions tending to have higher levels of organic matter and nutrients like potassium, phosphorus and sulphur, than middle or upper slope positions.

This spring, the study will be entering its eighth year. That may sound like a long time, but in terms of the statistics of soil sampling, it's just the beginning. Cathcart explains, "Unlike small plot research, we don't do repeated measurements at a given site. So we have to essentially assign the repeats over a number of years. Other scientists have said we are just moving into an area where we may be able to start picking up trends in some of the results after seven years."

Another major factor is that, unlike small plot research, the benchmark study does not apply any specific treatments to the sites. Cathcart says, "The producers go about their normal management practices. That allows us to more easily grasp how current production practices are really being used and how they are affecting soil properties." But it also means that more years of data collection are needed to sort out the effects on soil quality of the different crops and practices used in each year of the producer's crop rotation.

In fact, one of the study's most complex considerations is analyzing the effects of agricultural management. Cathcart is looking forward to the challenge of finding the best way to present and analyze the long list of data collected each year on such things as tillage and tillage dates, crop rotations, fertilizer products, rates and timing, and herbicide products, rates and dates.

Cathcart says, "We have a very strong baseline dataset – and an increasingly strong one as each year goes by – that will allow us to move forward into different areas, to validate pretty much anything we want to look at. ...It's exciting in that it allows a lot of future opportunities, including opportunities to work in partnership with other academic and government institutions."

For more information on this study, visit www.agric.gov.ab.ca/soilquality.

Learning about the Latest on Soil Quality

Parkland Conservation Farm

PCF extension activities help producers keep up with the latest in sustainable production.

The Parkland Conservation Farm (PCF) serves up extension programs spiced with results from on-the-spot research. And the practices on the menu all feature healthy soils.

Since 1992, PCF has been a learning centre for producers, youth and others on sustainable crop and livestock production. This 600-acre working farm near Vegreville is operated by the Parkland Conservation Farm Association, an independent, non-profit organization.

PCF Extension Coordinator Kelly Montgomery conducts tours, demonstrations and other extension activities throughout the year. Her programs keep producers up to date on management options that provide economic and environmental benefits, including improved soil quality.

For example, Montgomery says, "PCF has teamed up with Reduced Tillage LINKAGES and AAFRD's AgTech Centre to compare residue managers for direct seeding into heavy crop residues." This trial, which will be extended to a second year in 2005, is assessing the performance of various ground openers in terms of crop emergence, plant density and yields. She adds, "Producers are quite interested to see the new technology for residue managers."

"This landscape variability is the reality that farmers have to deal with."

Another example is a pasture re-establishment demonstration funded by the National Greenhouse Gas Mitigation Program. Montgomery says, "We are promoting the use of direct seeding to re-establish forage stands, rather than using tillage and then re-seeding. You're seeding right into an existing field, so soil carbon is conserved as well as soil moisture and fertility, and you save a lot of time because you're not crossing over the land three or four times."

PCF has been home to a wide variety of research studies since its inception. Along with the advancing scientific knowledge, the studies enrich PCF's extension activities. For instance, when Montgomery talks to producers about different tillage systems, she can draw on results from a long-term PCF study that found significantly higher total organic carbon and total nitrogen in the soil of a direct seeded site as compared to a conventionally tilled site.

PCF's major partners are: Agriculture and Agri-Food Canada; Alberta Agriculture, Food and Rural Development (AAFRD); Ducks Unlimited Canada (DUC); North American Waterfowl Management Plan; and local municipalities, farmers and agri-businesses. If you are interested in visiting the farm or learning more about its programs, call the PCF at 780-632-2244.

Soils, landscapes & greenhouse gases

Another soil-related research study at PCF is the Agriculture and Wetlands Greenhouse Gas Initiative. The multi-agency, multi-disciplinary initiative began in fall 2002 and will run until at least 2007. Funded by DUC's Institute for Wetland and Waterfowl Research, the initiative is composed of five interlinked projects to study greenhouse gas dynamics in prairie agricultural landscapes including wetlands.

Tom Goddard of AAFRD is leading the study's project in Alberta. Around three small wetlands at PCF, the research team is monitoring the three main greenhouse gas considerations in agriculture – methane emissions, nitrous oxide emissions, and carbon storage – along with other characteristics such as soil moisture, crop yield and wetland biomass.

Goddard says PCF was chosen as the initiative's Alberta site partly because "the farm is rich in baseline data" after so many years of hosting research and demonstration projects. As well, the PCF staff carry out the sampling of the soil gas emissions.

Having people on-site to do the sampling is especially useful because of the project's unusually intensive sampling protocol. They must collect samples several times a week during periods when greenhouse gas emissions are high (such as spring thaw) to capture each emission event, and their monitoring season lasts from March to November for a more complete annual record. And the most distinctive feature of this protocol is its landscape approach. For each wetland, they collect samples at seven or eight points along a transect, starting at the hilltop and going right down to the deepest part of the wetland.

Goddard says, "I don't know of anybody else who is measuring greenhouse gases emissions on a landscape basis, so other [researchers in Canada and the U.S.] are quite interested in our data." He adds, "This landscape variability is the reality that farmers have to deal with."

Another unusual element of the project is that the three wetlands are dry for part of the year. Like many prairie wetlands, they fill up with spring runoff and then dry out in the summer, except perhaps after rainstorms. Their wetting and drying cycles affect emissions.

As a result, the project is providing a host of new information on the variability of emissions across a landscape and over time that will improve calculations of Canada's national greenhouse gas emissions inventory.

COUNCIL PROFILES

Debra Lozinski

The Agricultural Research and Extension Council of Alberta (ARECA) and its member associations are key players in Alberta's agricultural extension scene. Through applied research and technology transfer, they provide up-to-date information tailored to local conditions so producers can improve their profitability and sustainability.

"We're the middle man between the researchers and the producers," explains Debra Lozinski, vice-chair of ARECA. This provincial body is composed of 14 non-profit, producer-driven applied research and forage associations.

She notes, "Each area has different needs and interests. I think that's our strength – that we can be diverse in each geographical region and based on the type of producers that we're working with." The member associations are involved in such activities as crop and variety testing, grazing management workshops, and demonstrating beneficial management practices.

Lozinski came to be a part of ARECA through her local association – the Lakeland Applied Research Association (LARA). LARA's wide-ranging activities also include projects on niche market opportunities, like organic farming and production of natural health products.

ARECA's associations often work in partnership with other agencies like municipalities, colleges and businesses. Several have partnered with AESA over the years, through its Farm Based Program and by working with local AESA-funded rural extension staff.

"It pays to be environmentally sustainable."

ARECA was created in 2003 when the Alberta Forage Council amalgamated with Alberta's applied research associations. "ARECA was formed to advocate on behalf of our member associations and to build partnerships at a provincial level," says Lozinski.

Lozinski became ARECA's representative on AESA Council in the fall of 2004.

Roger Bryan/AAFRD

She grew up near Hylo, Alberta on a mixed farm. After going to the University of Alberta and working in Edmonton for a few years, she moved back to the Hylo area. She now farms on her grandfather's homestead, focusing mainly on cow-calf production. Off-farm, she does contract teaching and works on several committees and boards. She also spent six years in municipal politics, serving as a councillor and a reeve for Lakeland County. During that time, she sat on various committees related to environmental issues.

Lozinski sees environmental stewardship as important for everyone, including producers. She says, "Many of the changes to become more environmentally sustainable are economically beneficial to producers as well. From a business perspective, it pays to be environmentally sustainable.... It's also about doing our part as an industry. It's important that we demonstrate that agricultural producers are being progressive and addressing these issues."

Dave Hegland

As the new representative of the Alberta Pulse Growers on AESA Council, Dave Hegland sees some key linkages between the two agencies. For example, one of AESA's major priorities is to encourage integrated crop management systems. Pulse crops – like peas, beans, lentils and chickpeas – play a valuable part in these environmentally sound production systems.

"Pulses are some of the most environmentally friendly crops to grow," says Hegland. "They are fairly low-input crops. They add nitrogen to the soil as opposed to taking it out. And typically, if your land is fairly clean, you don't have too many weed problems."

He notes, "The Alberta Pulse Growers [APG] has worked on the idea of including pulse crops in a rotation, as opposed to using them as a cash crop one year and then not growing them again." Adding pulses to a rotation can help to break weed, disease and insect pest cycles, and to improve soil quality. So, as more and more producers include pulses in their crop rotations, the pulse industry grows and the environment benefits.

Roger Bryan/AAFRD

"Pulses are some of the most environmentally friendly crops to grow."

Hegland recently retired from the APG board after nine years, serving as vice-president, then president and finally past-president, as well as working on various committees. The APG is a producer-run organization aimed at encouraging the growth of a viable, profitable pulse industry in Alberta. In his time on the board, Hegland saw Alberta's pulse production expand from about 200,000 acres to nearly 800,000 acres.

The APG is very active in sponsoring and assisting in research and extension to help improve Alberta's pulse industry. "Agronomy is a big part of what we do, so farmers will feel comfortable growing this crop. There's a lot of risk involved in farming nowadays, ...so we put Pulse Grower money into applied research and demonstrations of new techniques," explains Hegland.

He adds, "We've also done a fair amount of work on some initiatives to increase market opportunities for pulses. For example, the inclusion of peas in hog rations has been an important focus. We've done a lot of research projects that determine the net energy in the crop so that people using this product in their rations know what exactly they are using."

Hegland and his wife have a pedigreed seed operation in the Wembley area (near Grande Prairie). They grow registered and certified cereals, oilseeds and pulses, using a minimum tillage system.

Harvesting Soils Data

The development of the Agricultural Region of Alberta Soil Inventory Database (AGRASID) – the comprehensive soils database for Alberta's entire agricultural area – is enabling such diverse applications as targeting extension programs and modelling appropriate land management. Another enhancement now on the horizon will give users an even better look at the data.

"...we knew what we had to do, but how were we going to do it?"

Tony Brierley, a soil scientist with Agriculture and Agri-Food Canada (AAFC), has been involved with AGRASID's development since its inception in 1992. At that time, with funding under a federal-provincial sustainable agriculture program, people from AAFC, the Alberta Research Council and numerous private consultants collaborated to create the database.

"We had been told to create a digital, seamless, 1:100,000 scale database for the agricultural region of Alberta. So we knew what we had to do, but how were we going to do it?" says Brierley. "The biggest hurdle was to design the database structure in order to digitize and standardize all the hard-copy soil maps. The vintage of the maps ranges from the 1930s right through to 1990. We had a lot of different map scales, map symbolization and mapping concepts to convert into one consistent format, so you could go from one county to the next and have the lines all match, the concepts all flow, and descriptions be the same."

This painstaking work included transferring detailed information from the maps, as well as interpreting air photos and field checking to update the early maps. "It was a major task," notes Brierley. "There were close to 50 people involved in one way or another in the project from 1993 to 1998."

The first version of AGRASID, released in 1998, was available on CD. Between 1998 and 2001, AAFC and Alberta Agriculture staff worked with some consultants to make modifications to the database, resulting in easier and faster manipulation of the soil landscape information, and in distributing AGRASID on the Internet.

More recently, the developers have created a specialized viewer, which they hope to have available on the Internet soon. Without this viewer, AGRASID simply lists the type of landscape in each polygon and the proportion of the landscape occupied by each soil type in the polygon. The viewer enhances this, Brierley explains. "For instance, we've said eroded soils generally occur on the knolls, Chernozems usually on the upper and mid slopes, Solonetz soils on the lower slopes, and poorly drained soils in the depressions, and we've represented this distribution on a 2-D image of the landscape. Also we have included some pictures of the more extensive types of landscapes. So we are helping users to visualize what they would find in each polygon. We are also including colour air photographs with the soil lines superimposed on them."

Policy planners are using AGRASID in conjunction with other databases to investigate a wide variety of issues. "If you give us criteria based on attributes in the database, we can theme the data on those attributes," notes Brierley. "For example, we were involved in deriving a series of themed maps and overlaying those themed maps with additional sources of information to determine focus areas of high priority for conducting Environmental Farm Plan workshops."

To access AGRASID, go to www.agric.gov.ab.ca and search for "Alberta Soil Information Centre". You can also order hard-copy soil maps and reports from the Centre.

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Green Matters is the newsletter of the Alberta Environmentally Sustainable Agriculture (AESA) Council. AESA Council consists of representatives from Alberta's agriculture and food processing industry, environmental organizations and municipal, provincial and municipal governments.

AESA Council's vision is that Alberta has a thriving agriculture and food industry that is operating in an environmentally responsible manner. Its mission is to lead the agriculture and food industry in addressing environmental challenges. And its goal is to develop and deliver collaborative environmental stewardship initiatives that result in sustainable growth of Alberta's farm, ranch and agri-food processing industry.

The purpose of *Green Matters* is to provide a forum for discussion of environmental issues in Alberta's agriculture and food processing industry.

To subscribe to *Green Matters*, call 780-422-4385. *Green Matters* is also available online at <http://www1.agric.gov.ab.ca>.

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